TAUOLA and PHOTOS Interfacing

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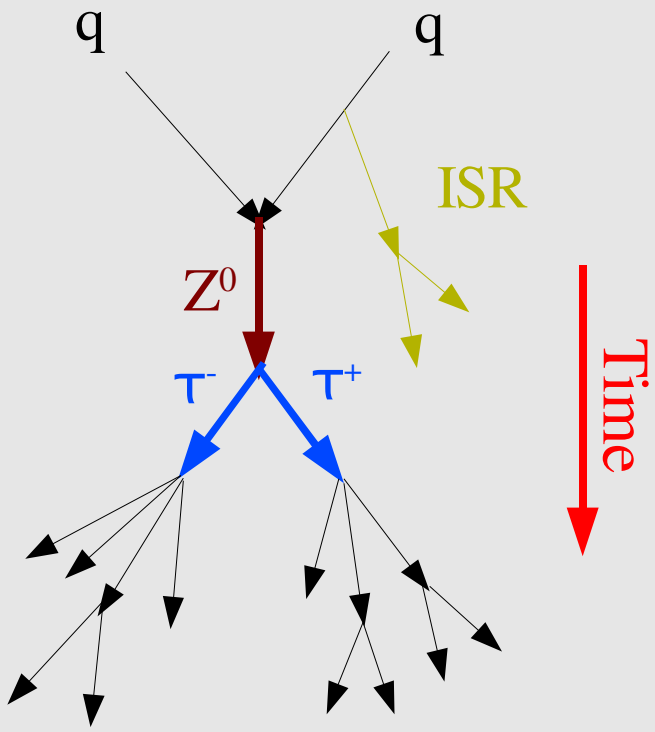
- Event record design defficiencies
- TAUOLA and PHOTOS requirements
- Actual conditions in interfacing to PYTHIA 6.2 and HERWIG 6.5

Event listing (summary)

I	particle/jet	KS	KF	orig	p_x	p_y
1	!p+!	21	2212	0	0.000	0.000
2	!p+!	21	2212	0	0.000	0.000-
3	!g!	21	21	1	-0.921	0.504
4	!u!	21	2	2	-0.283	-0.339-
5	!ubar!	21	-2	3	-0.506	-4.407
6	!u!	21	2	4	0.224	0.213-
7	!Z0!	21	23	5	-0.283	-4.195-
8	!tau-!	21	15	7	-27.957	6.614
9	!tau+!	21	-15	7	27.674	-10.808-
10	(Z0)	11	23	7	-0.283	-4.195-
11	(tau-)	11	15	10	-27.957	6.614
12	(tau+)	11	-15	10	27.674	-10.808-
13	(u) A	11	2	3	-1.865	2.571
14	(g) V	11	21	3	0.226	0.541
15	(g) A	11	21	3	0.652	-0.798
16	(ud_0) V	11	2101	1	0.625	-0.316
17	(u) A	11	2	0	-2.646	3.096

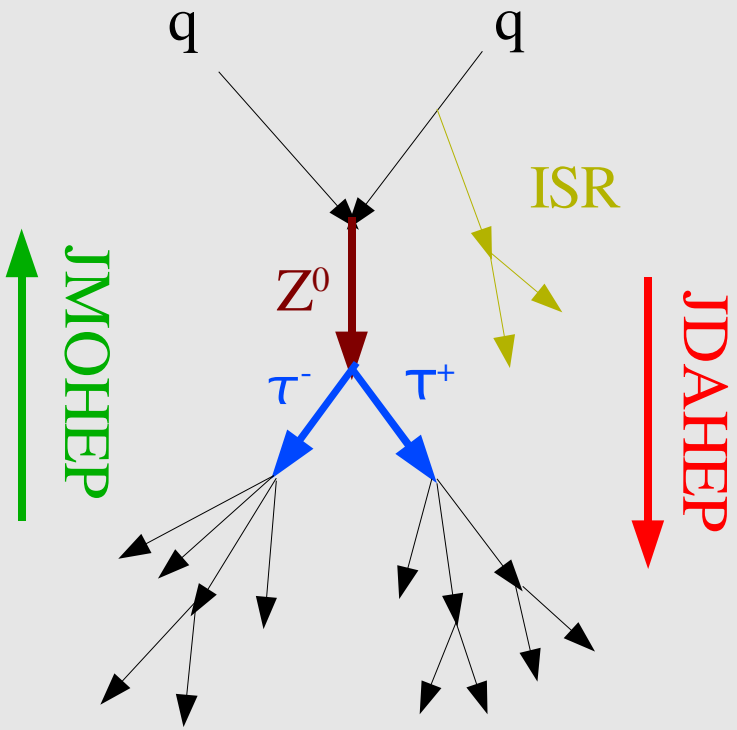
Event Record Design

- Idealistic/physical representation of a process:
  - Event evolution with a well defined timeline
  - Four-momentum conservation at each vertex
  - Turns out to be a naïve picture...



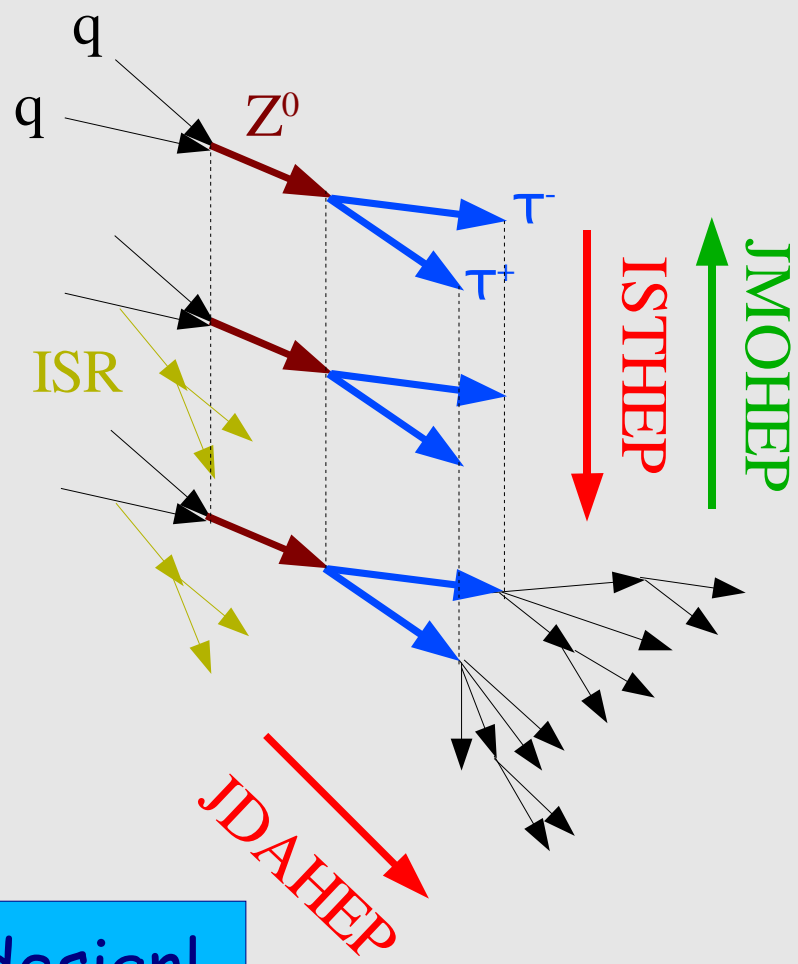
Event Record Design II

- HEPEVT design follows this model
  - → JDAHEP(I,IPART) points in the time direction
  - → JMOHEP(I,IPART) points in the opposite direction
  - → Clearly this offers some redundancy:
    - Generally exploited to store additional information



Event Record Design III

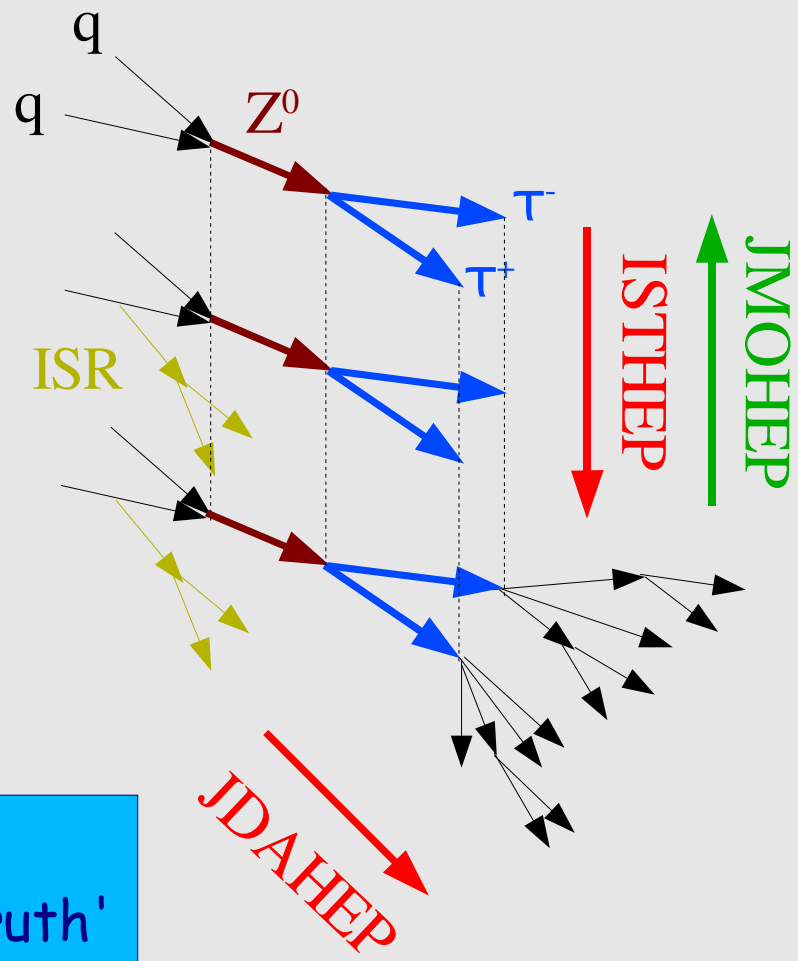
- Formulation of the problem:
  - This is not how a Monte-Carlo event generator works
  - Generation starts from the hard process, the subsequent effects (like ISR) are added 'perturbatively'
  - Multiple particle copies, modified kinematics!
  - Relations handled using the 'overloaded' JMOHEP/JDAHEP



Fine, but there is no unique design!

Event Record Design IV

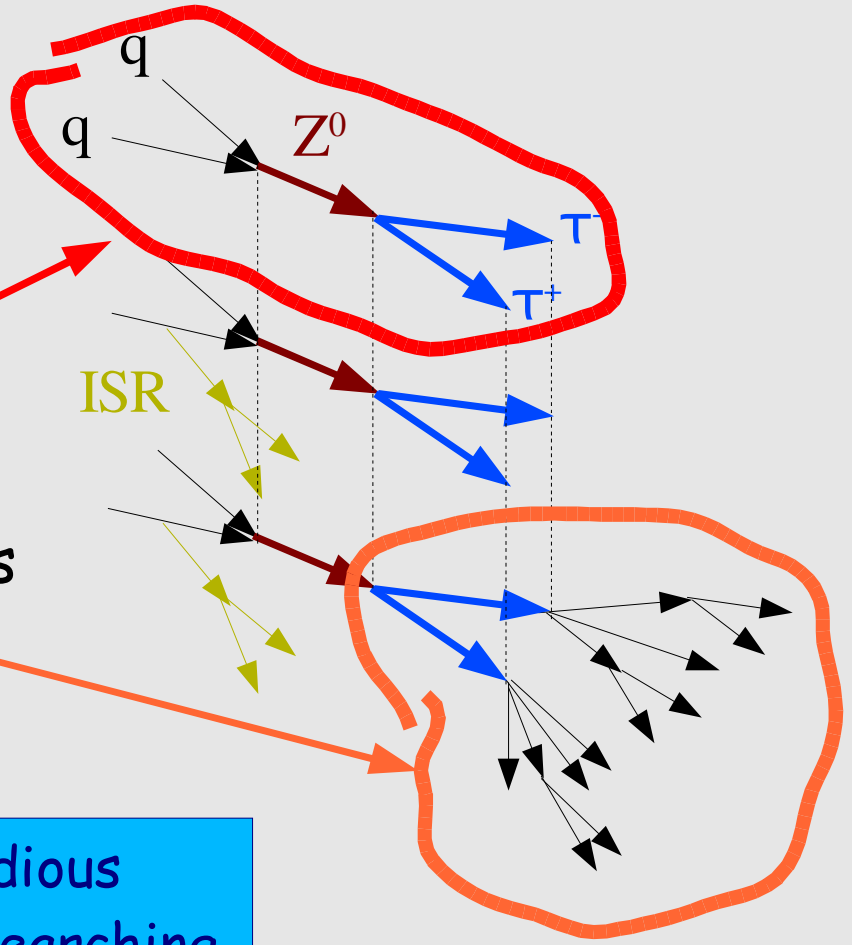
- Problems arise when one wants to access:
  - → The hard process info (TAUOLA)
  - → Follow the particle cascade (PHOTOS)
  - → Since there is no unique design:
    - Dedicated access methods
    - No general proof of correctness
    - Exceptions are always possible



The information should be there!
Experimentalists are interested in 'MC Truth' as well as particular effects (ISR..)

Tauola-related issues

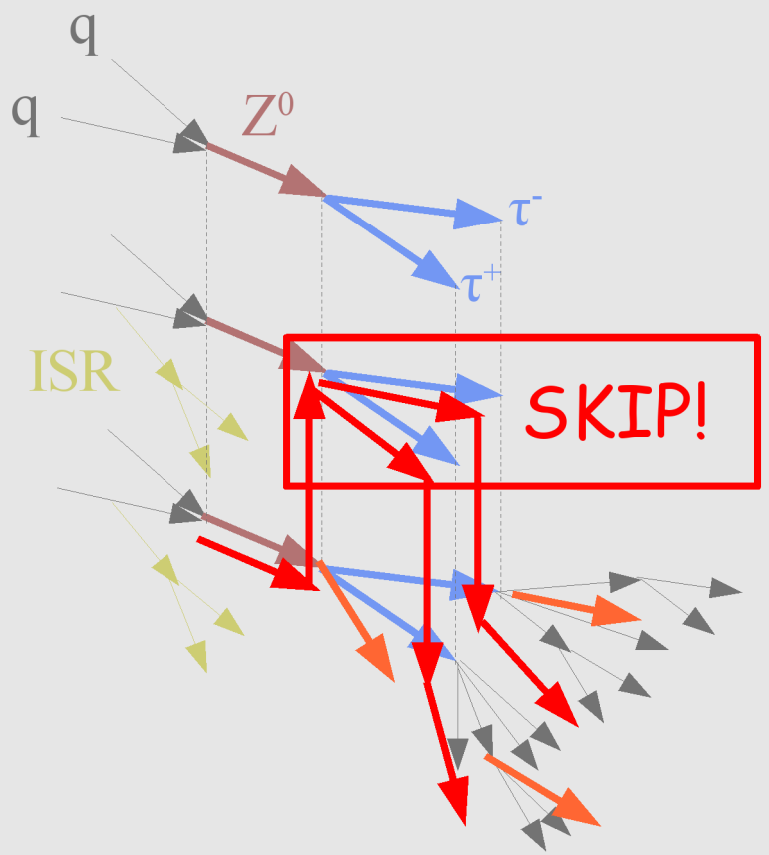
- Tauola generic interface:
  - → Interfaces to the generator via the HEPEVT common block
  - → Needs the hard process data to calculate the polarisation info
  - → Performs the τ decays
  - → Has to locate the 'final' τ entries to add the decay products



Certainly can be done but involves tedious 'probings' over the event record when searching for a particle with an adequate status code....

Photos-related issues

- Photos generic interface:
  - Interfaces to the generator via the HEPEVT common block
  - Adds photon radiation to leptons and hadrons
  - Needs the information of the whole decay cascade of a particle in order to correct the kinematics where necessary
  - Follows the JDAHEP directions

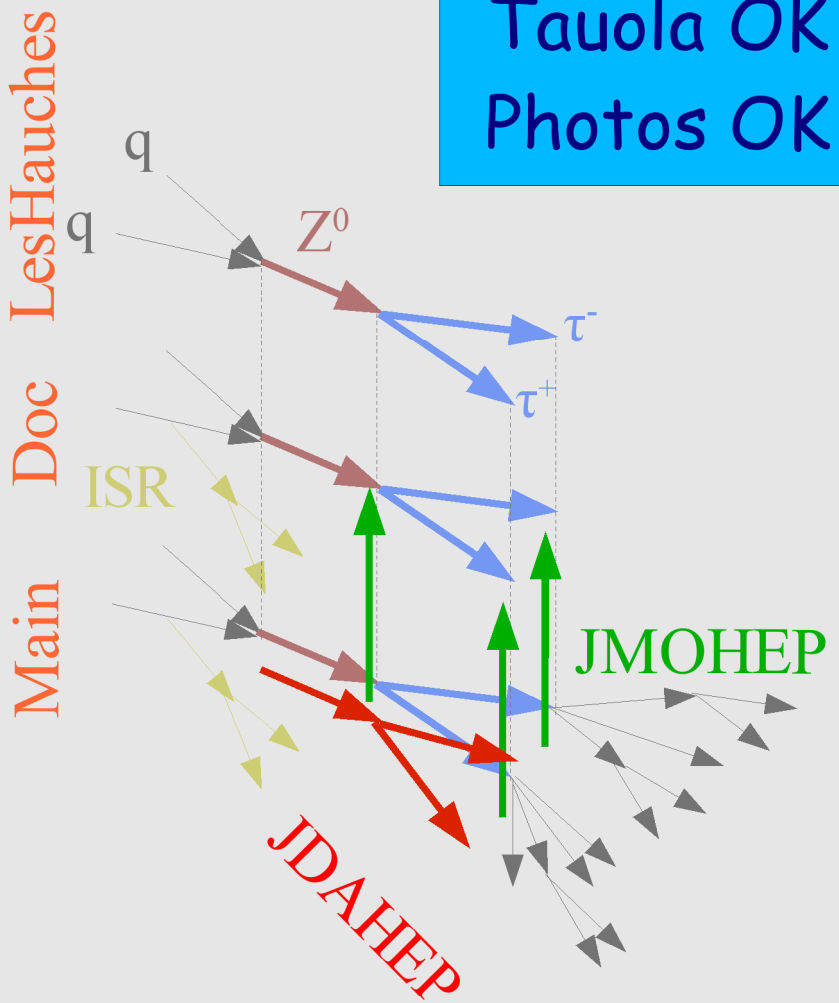


Example of a JDAHEP 'path' that PHOTOS has to handle!

HEPEVT flavours - Pythia

- Pythia modes of filling the HEPEVT common block:
  - → MSTP(128)=0 (D):
    - Resonance copies stored in the main record, JMOHEP points backwards to the hard record
  - → MSTP(128)=1:
    - Resonance copies stored in the main record, JMOHEP points backwards related to JDAHEP
  - → MSTP(128)=2:
    - Same as MSTP(128)=1, no products in documentation sect

Tauola OK
Photos OK



Excellent documentation!

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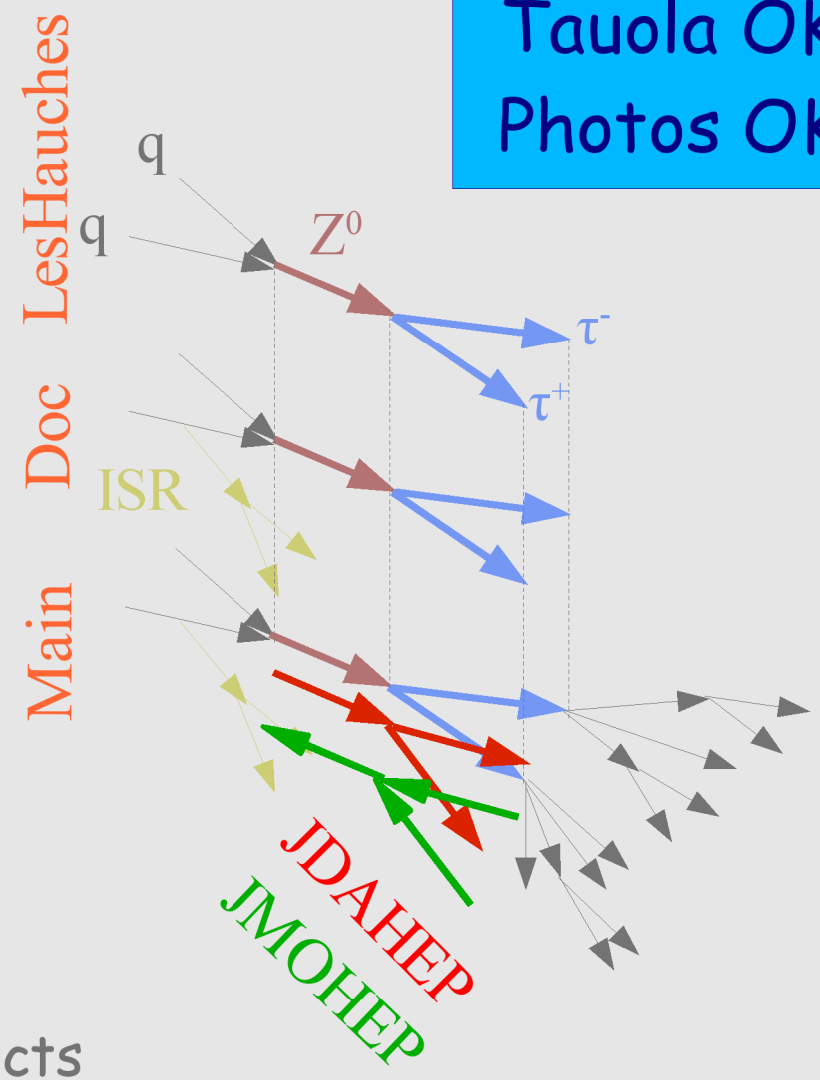

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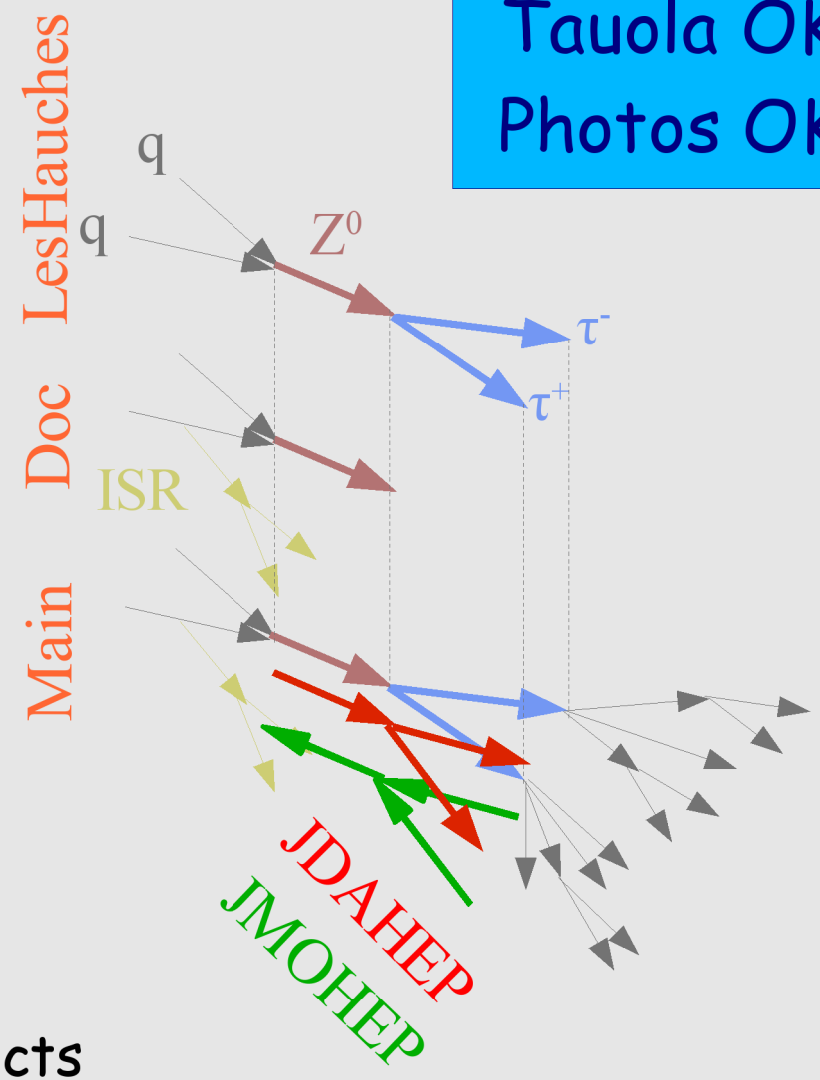
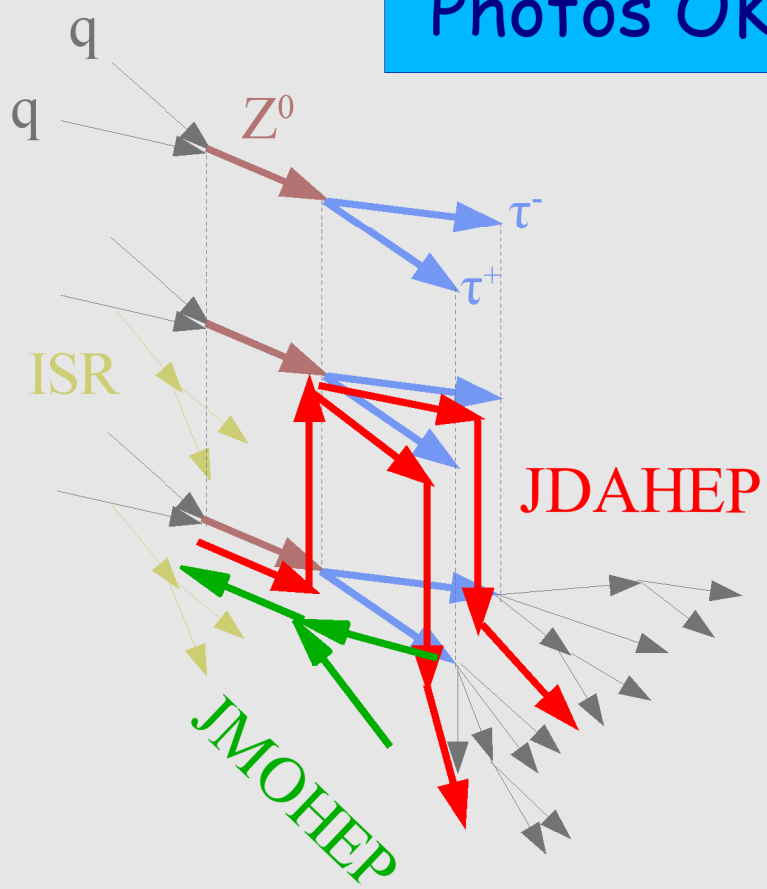


HEPEVT flavours - HERWIG

- HERWIG mode of filling HEPEVT:
  - → Uses it internally for event generation
  - → Everything possible is stored
  - → Heavily overloaded usage
  - → A lot of exceptions to the 'rule':
    - 'Hard CMS' entry (ID=120) is sometimes also a resonance entry....
    - Makes it difficult to handle
  - → Poor documentation....

Tauola OK
Photos OK



Conclusions and Summary

- With the present flavours of HEPEVT overloading the interfacing of external packages like TAUOLA and PHOTOS is barely manageable...
  - → No formal proof of correctness possible – checking an ongoing process..
  - → Documentation about the HEPEVT handling helps a lot!
  - → One should have in mind that the future event records might suffer from the same defficiencies unless the MC generation process is taken into account!